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FROM: PROI (STINFO) 20 May 2002

SUBJECT: Authorization for Release of Technical Information, Control Number: **AFRL-PR-ED-AB-2002-124**
Bruce Chehroudi (ERC) and Doug Talley (PRSA), "Coaxial Injection Under Supercritical Conditions"

41st Aerospace Sciences Meeting & Exhibit **(Statement A)**
(Reno, NV, 6-9 January 2003) (Deadline = 06 June 2002)

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PHILIP A. KESSEL Date
Technical Advisor
Space and Missile Propulsion Division

AB-02-124

Coaxial Injection Under Supercritical Conditions

B. Chehroudi and D. Talley

This work reports on findings from the initial phase of a coaxial injection process under both subcritical and supercritical conditions. The results presented here are part of a systematic and investigation of common rocket engine injectors, such as impinging and coaxial designs. Liquid nitrogen (LN_2) is injected through a large length-to-diameter ratio circular hole and exposed at the exit to an annular jet of different gases including nitrogen, helium, and argon. The length-to-diameter ratio is sufficiently large to ensure fully-developed turbulent pipe flow at the exit plane. The behavior of the central LN_2 jet has already been analyzed extensively and reported in our earlier published works, for example, *Chehroudi et al. [1, 2]*. Experiments were conducted by injecting LN_2 into a room temperature, high-pressure chamber with full optical access from four directions. The stainless steel chamber can withstand pressures and temperatures of up to 13.6 MPa and 473 K, respectively. Liquid nitrogen is used to cool and/or liquefy the gaseous nitrogen passing through the cryogenic cooler prior to injection. The mass flow rate of the injectant is measured and regulated by way of a mass flowmeter, and a precision micrometer valve. A model K2 Infinity long distance microscope is used to form images of the injected jets on a high resolution CCD camera by the Cooke Corporation.

Results concentrate on the interaction of the annular gaseous jet with the core LN2 jet only in the initial region of the mixing layer formation. The initial jet growth rate was measured in order to investigate the effects of some flow and thermodynamic parameters of the annular gas on the core LN2 jet. The results are compared with our reference data when no annular gas jet was used.

1. Chehroudi, B., Talley, D., and Coy, E. Visual characteristics and initial growth rates of round cryogenic jets at subcritical and supercritical pressures, *Physics of Fluids,* Vol. 14, No. 2, February 2002.
2. Chehroudi, B. , Cohn, R., and Talley, D. Cryogenic shear layers: Experiments and phenomenological modeling of the initial growth rate under subcritical and supercritical conditions, *International Journal of Heat and Fluid Flow*, 2002. (To appear)

An abstract to:

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